Data Distribution & Processing CSCI
Data Health CSC
Requirements and Design Specification

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System Engineering and Integration

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1. Data Distribution & Processing CSCI

The Data Distribution & Processing CSCI is composed of the following CSCs:

Data Distribution CSC, Data Fusion CSC, and Data Health CSC.

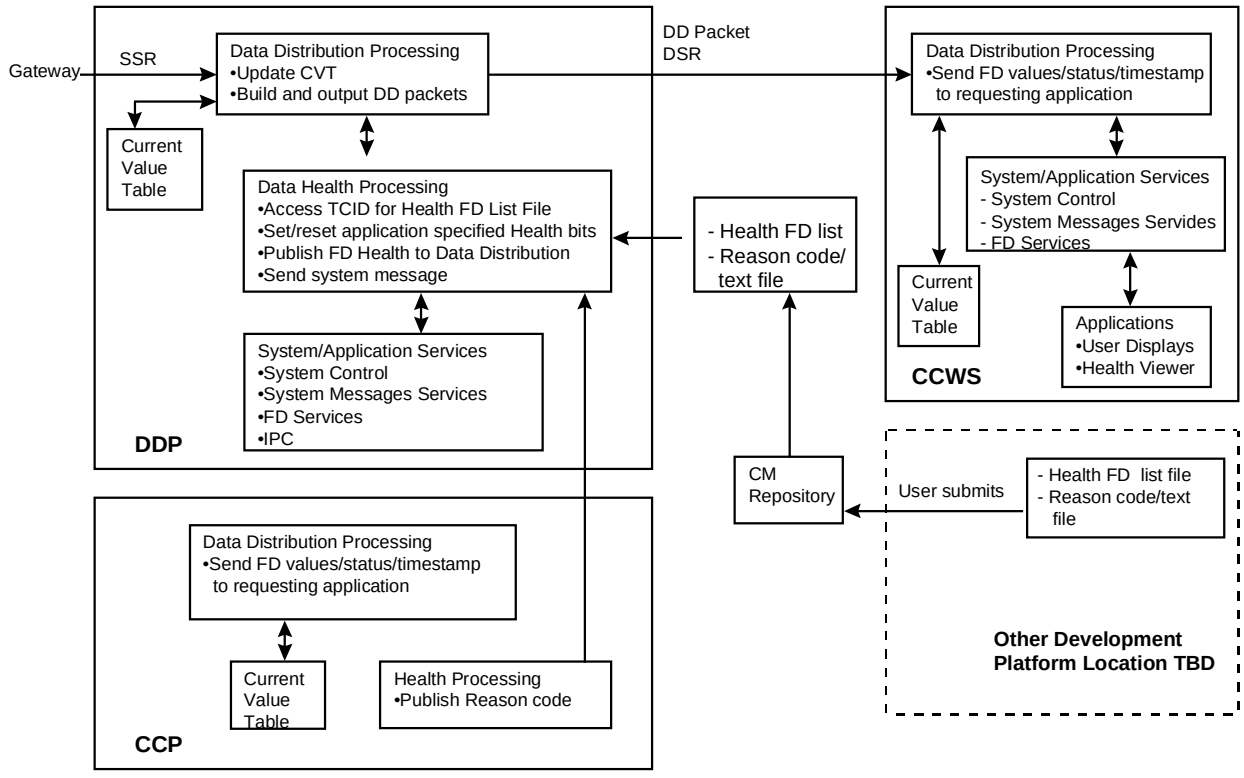
1.1 Data Health CSC Introduction

1.1.1 Data Health CSC Overview

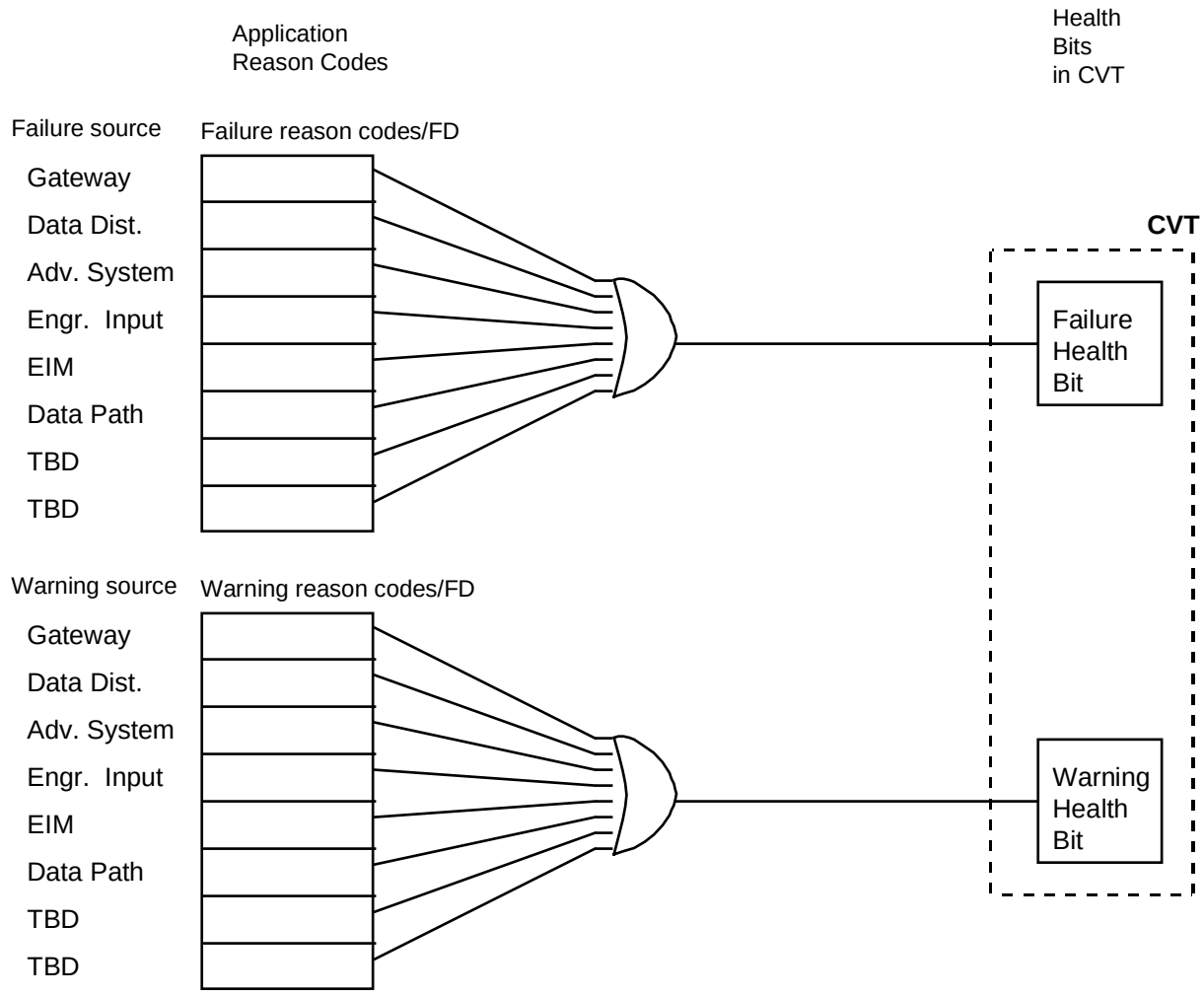
Data Health is the term applied to the integrity and validity of a Function Designator (FD) value which is being distributed from a CLCS subsystem. The health of an FD may represent the state of a hardware component, a communication path, resultant data from a Fusion operation, or application data. The boundaries of the data health measurement are the sending of the data by a component at one end of the data path and the receiving of data by a component at the other end. The status of the Data Health bit, as valid or invalid, determines the usability of the data.

The Data Health CSC is the software component that applies health status to each FD processed by the DDP, and provides the health status to applications at the CCWS and CCP via Data Distribution.

Data Health CSC Overview is as follows:



Data Health Processing Concept



Each FD received from the gateway is accompanied with status described by two bits, a failure bit (Sf), and a warning bit (Sw). When the failure bit is set, it indicates that the FD value should be ignored. When the warning bit is set, it indicates that the validity of the FD is questionable, and that an operator or engineer intervention/decision may be needed.

The following examples of conditions that can set reason codes:

- Set to failure condition (ENGf) or warning condition (ENGw) by an engineer.
- Set to warning condition by Data Distribution based on application request.
- Set to warning condition (ADVISORY) by an Artificial Intelligence Application.

After any additional condition is applied to an FD, Data Distribution will compute the resultant health of the FD based on the gateway status and the current health conditions of the FD. Computation is done by OR'ing the Gateway failure bit with the failure conditions, and OR'ing the Gateway warning bit with the warning conditions. The resultant health, which will be represented by two Health bits (Hf and Hw), will be incorporated into Data Distribution, which will subsequently be distributed to all platforms, and made available for application access via FD Services.

1.1.2 Data Health CSC Operational Description

Data Health can be divided into two segments, a user development segment, and a run time segment.
The user development segment involves:

- Off-line definition of Data Health FD list
- Off-line definition of Health reason code text

The run time segment consists of :

- Applying data health on FDs received at the DDP by the Data Health Manager. (Redstone)
- Storing data with health information in the CVT and making the data accessible by application via Data Distribution. (Redstone)
- Loading the Data Health FD list Table during DDP initialization.
- Applying data health on FDs received at the DDP, based on Gateway and applications defined for the FDs.

1.2 Data Health CSC Specifications

1.2.1 Data Health CSC Ground Rules

1. Data Health CSC will make use of Data Distribution API to obtain and store health information from/to the CVT.
2. Data health information will be made available for applications access at the DDP, CCWS, and CCP via Data Distribution.
3. Applications~~, with exception of Data Health Manager and Data Fusion Manager,~~ will obtain data health information via FD Services.
4. ~~Goal is to use COTS tool selected for Fusion Editor to support Data Health requests.~~
5. Redundancy management will not be supported (future requirement).
6. Persistent data/checkpoint will not be supported.
7. The authentication check on assigning reason code will not be performed by Data Health.
8. The reason code validity check will not be performed by Data Health

1.2.2 Data Health CSC Functional Requirements

1.2.2.1 Data Health (DH) at the DDP

1. DH will provide the capability to load the DH FD List Definition file at DDP initialization.
2. DH will provide the capability to receive changed health data from CCPs
3. DH will provide the capability to compute the resultant health of FD(s), based on the gateway status and the current health conditions, and incorporate the result into the Data Distribution CVT.

1.2.2.2 Data Health (DH) at the CCP

1. DH will provide the capability to output changed health data to DDP.

1.2.2.3 Data Health (DH) at the DDP/CCP

1. DH will provide an application interface allowing applications to issue a health reason code for an FD or a list of FDs (via reference of the Group ID)
2. DH will provide an application interface allowing applications to retrieve health reason code for an FD or a list of FDs (via reference of the Group ID).
3. DH will provide an application interface allowing applications to retrieve the text associated with a reason code.

1.2.2.4 Data Health (DH) at the CCWS

1. DH will provide an application interface allowing applications to retrieve health reason code for an FD or a list of FDs (via reference of the Group ID).
2. DH will provide an application interface allowing applications to retrieve the text associated with a reason code.

1.2.2.3 *Data Health FD List Definition Editor (Future Delivery)*

1. The Editor will provide an Graphical User Interface (GUI) that allows user to:
   a. Select FDs from a scrollable list of valid FDs
   b. Define a list of FDs, whose health status will be set/reset, as requested by user
      - FDs in list
      - User specified FD list ID
2. The Editor will generate the Health FD list file.
3. The Editor will provide On-Line Help.

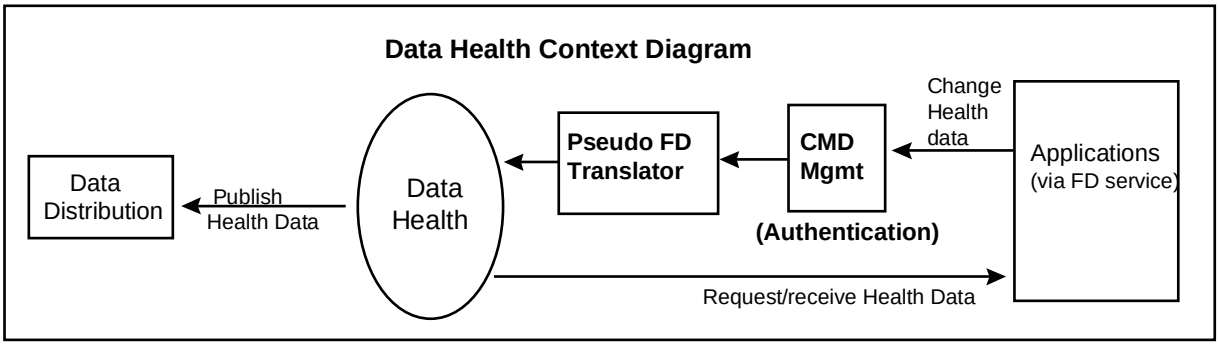
1.2.2.5 Data Health (DH) Test Tools

1. DH will provide the capability to issue reason code for an FD or a list of FDs.
2. DH will provide the capability to retrieve Data Health bits for an FD or a list of FDs.
3. DH will provide the capability to retrieve reason code for an FD or a list of FDs.
4. DH will provide the capability to retrieve message text associated with a reason code.

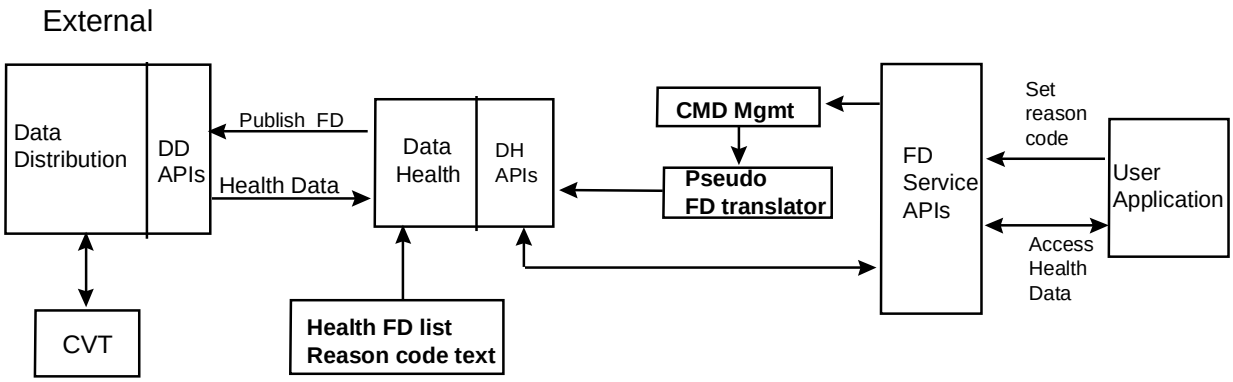
1.2.3 Data Health CSC Performance Requirements

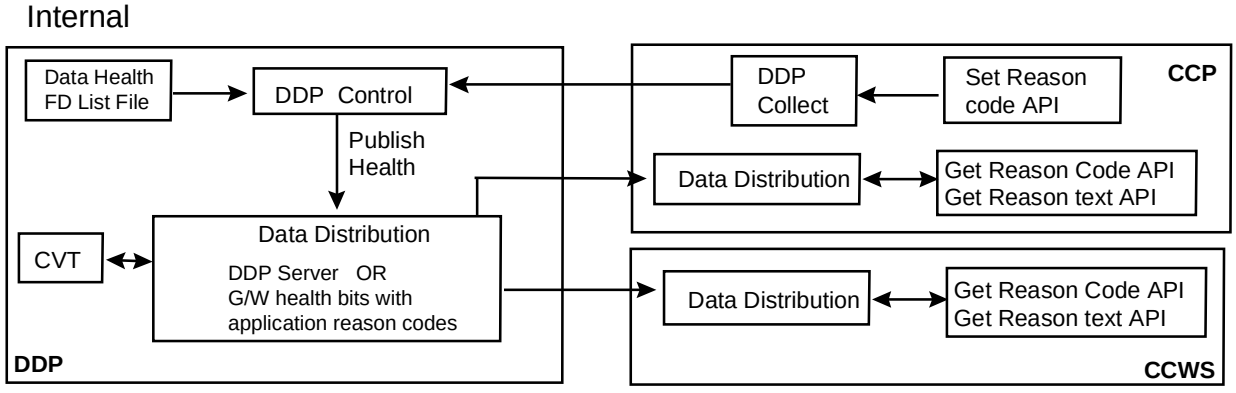
The Data Health Function will process up to the "system maximum data bandwidth" of FDs.

1.2.4 Data Health CSC Interfaces



1.2.5 Data Health CSC Data Flow Diagram





1.3 Data Health CSC Design Specifications

The Data Health CSC applies health status to each FD processed by the DDP and provides the health status to applications at the CCWS and CCP via Data Distribution.

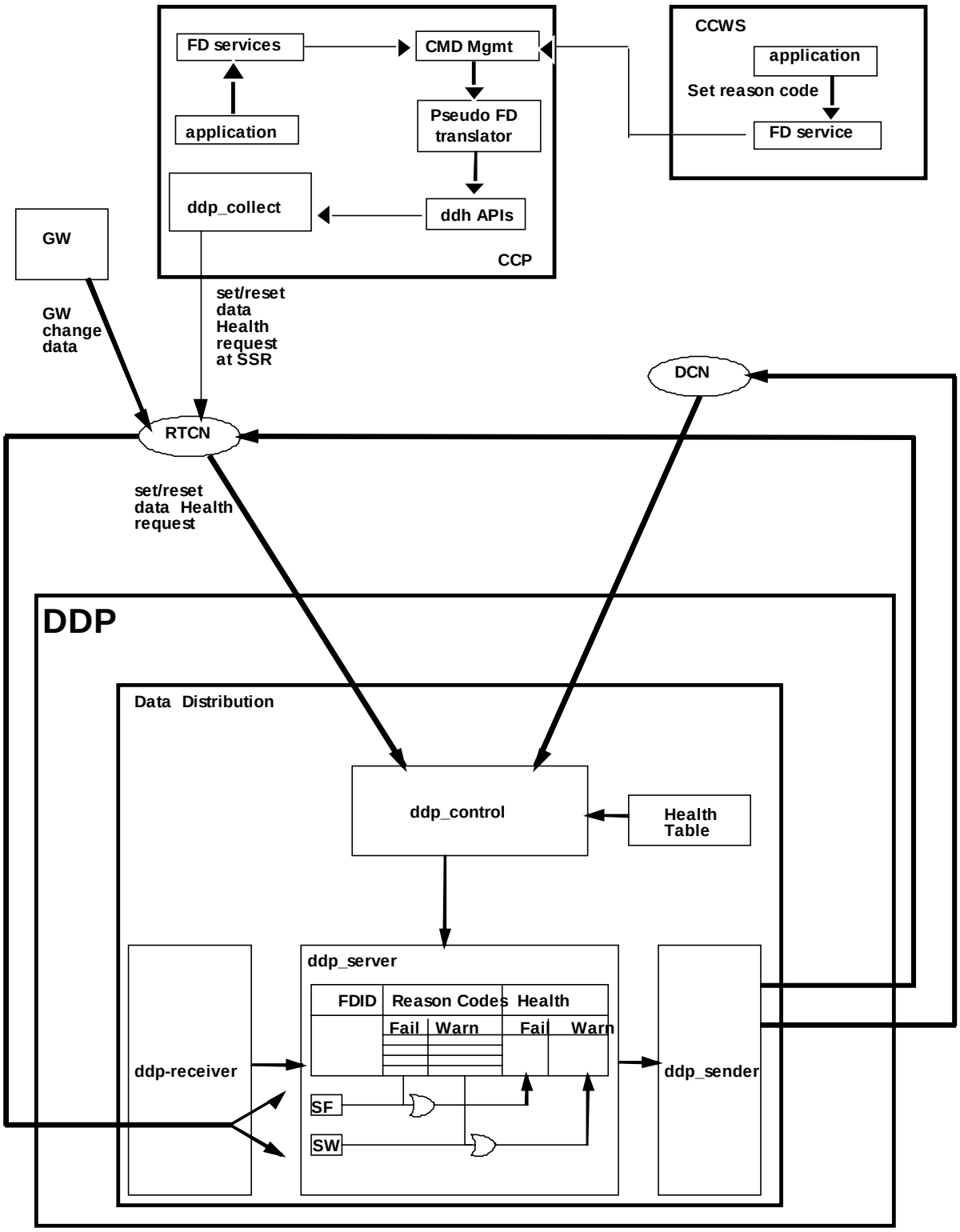
The Data Health CSC on the DDP will perform these functions:

1. Receive set/reset Data Health requests associated with an FD or a list of FDs from applications residing on the DDP, CCP, and CCWS platforms.
2. Process the resultant health of FDs based on the gateway status and the current health conditions (same as reason codes) of the FD(s).
3. Incorporate the resultant health into the CVT via the use of Data Distribution API. The resultant health will then subsequently be distributed by Data Distribution to all platforms and made available for application access via FD Services.

The Data Health CSC on the DDP/CCP/CCWS will provide application interfaces allowing applications to request set/reset Data Health and get Data Health reason codes and reason code message text.

1.3.1 Data Health Detailed Data Flow

1.3.1.1 DDP Detailed Data Flow



The Data Health CSC processing is performed partly in the Data Health application interfaces and partly by Data Distribution.

ddp_collect processing

- The ddp_collect process receives all data health, fusion, and display attribute requests from applications residing on the CCP.

  For Data Health messages

  - A request will be made to set/reset the condition codes for the requested ID or list ID.
  - The request is sent to the ddp_control process. The requests will be buffered at SSR intervals.

ddp_control processing

- The ddp_control process runs on the DDP and receives all C-to-C messages from the ddp_collect processes

  For Data Health messages

  - The Data Health file will be read in at initialization time.
  - The request type is checked, and if the request is an FD list ID, a list of FD names will be obtained from an FD list file. A request will be made to set/reset the condition codes for each of the requested IDs.
  - The Data Distribution APIs are called to store the condition code into the CVT and calculate the data health.

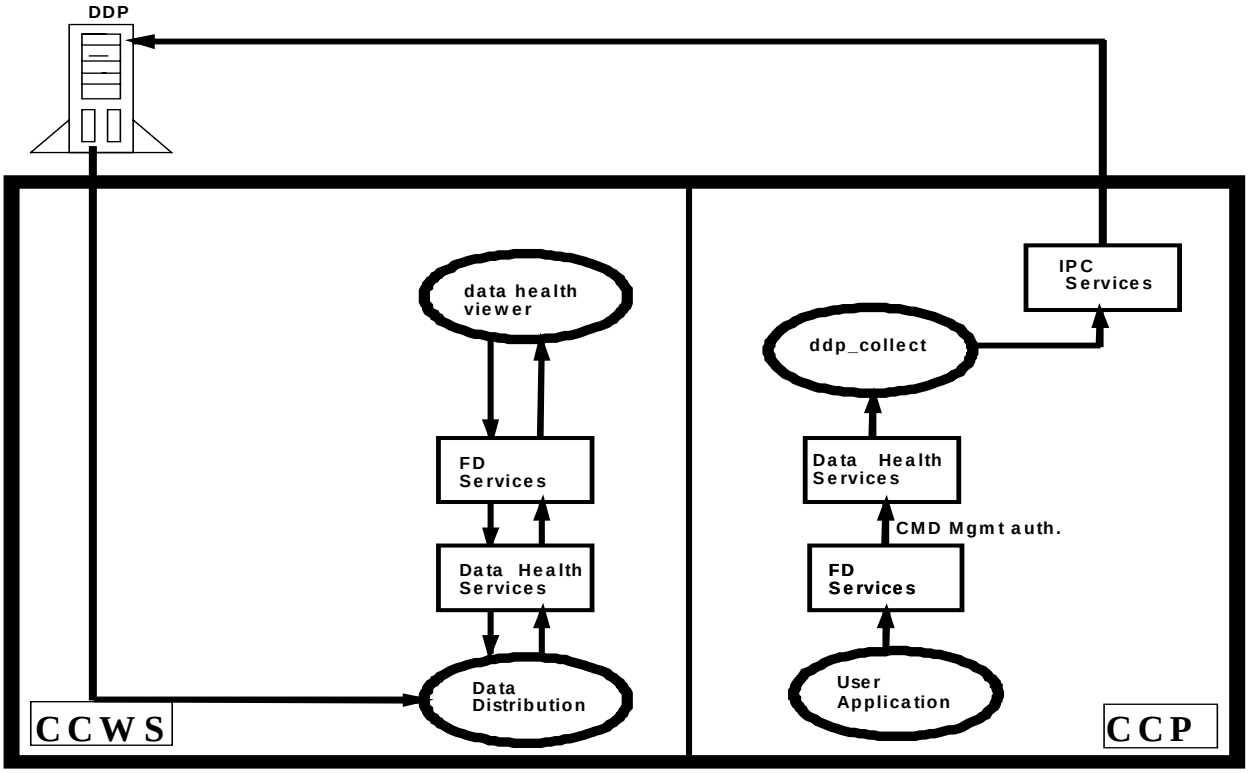
ddp_server processing

- Data Health Processing performed by Data Distribution includes:
  - Receiving gateway status bits as change data.
  - Whenever there is a change in gateway status bit, or in the reason codes

    'OR' the gateway status bit with the corresponding reason code summary (failure to failure, warning to warning)

    Store the result as corresponding health bits in the CVT
  - Output changed Health bits and reason codes in the Data Distribution packet to RTCN (at SSR) and DCN (at DSR).

1.3.1.2 CCP/CCWS Detailed Data Flow



On the CCP and CCWS, applications use FD services to set/reset reason codes. Command Management performs authentication on the request. FD translator passes requests to Data Health processor. IPC services is used to transfer the health request to the DDP to be stored in the CVT.

On the DDP/CCP/CCWS, applications use FD services to retrieve health data.

1.3.2 Data Health External Interfaces

Health Table

Group name	**# entries**
FD name	
FD name	
FD name	
FD name	
Group name	**# entries**
FD name	
FD name	
FD name	

A Group name references a list of FDs and/or other Group names.

1.3.2.1 Data Health Message Formats

Messages are defined in the Data Distribution CSC for ddp_control and ddp_collect.

1.3.2.2 Data Health Display Formats

There are no display formats for the Data Health CSC.

1.3.2.3 Data Health Input Formats

There are no input formats for the Data Health CSC.

1.3.2.4 Data Health Recorded Data

There are no recorded data for the Data Health CSC.

1.3.2.5 Data Health Printer Formats

There are no printer formats for the Data Health CSC.

1.3.2.6 Data Health Interprocess Communication

1.3.2.6.1 IPC Services

Refer to IPC Services CSC for a description of the IPC header format. The Data Health request/response message body format to be transferred by IPC Services is depicted below:

Request Type **1=Set health by FD Name(s)** **2=Set health by Group name**
FD Name / Group name
Reason Code
Set User
Warning/Failure Flag
. .

1.3.2.7 Data Health External Interface Calls

1.3.2.7.1 Data Health Interfaces

Allows the application to request Data Health processing of the specified FD or list of FDs, Data Path health condition associated with the FD(s). Also allows the calling application to reference a FD list ID, which represents a list of FDs defined in a FD list file

- **ddh_set_health**

  Inputs:
  - Set type 1=set by FD name(s)
    2=set by FD list name
  - FD name or FD list name
  - Condition Code
  - Set User (Data Dist., Adv. System, Engr. Input, EIM, Data Path, TBD)
  - Warning/Failure Flag

  Outputs:
  - Return code indicating success or failure. Error number if return code indicates failure.

- **ddh_get_reason**

  Inputs:
  - FD name
  - Warning/Failure Flag

  Outputs:
  - List of reason codes

- **ddh_get_reason_text**

  Inputs:
  - Reason Code

  Outputs:
  - Reason message text

1.3.3 Data Health Internal Interfaces

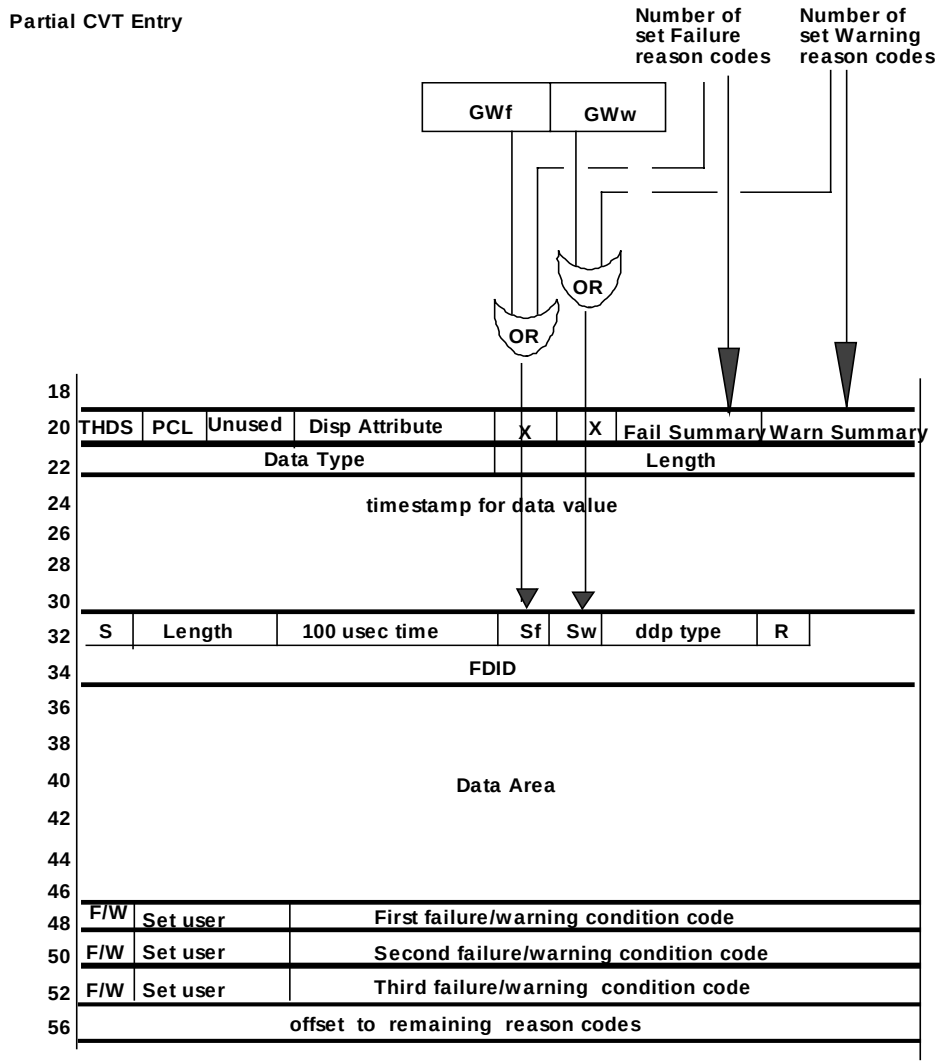
1.3.3.1 CVT Format for Data Health

The health information for each FD is stored in the CVT entry. Information includes:

- Reason codes (eight for failure condition, eight for warning)
- Health Bits (one for failure condition, one for reason)

Whenever the Data Health Table is updated via the Data Health APIs or the DDP APIs, the gateway status bit for each entry is OR'ed with the corresponding reason code summary. The result of the operation is the Data Health of each FD, which will be stored in the CVT.

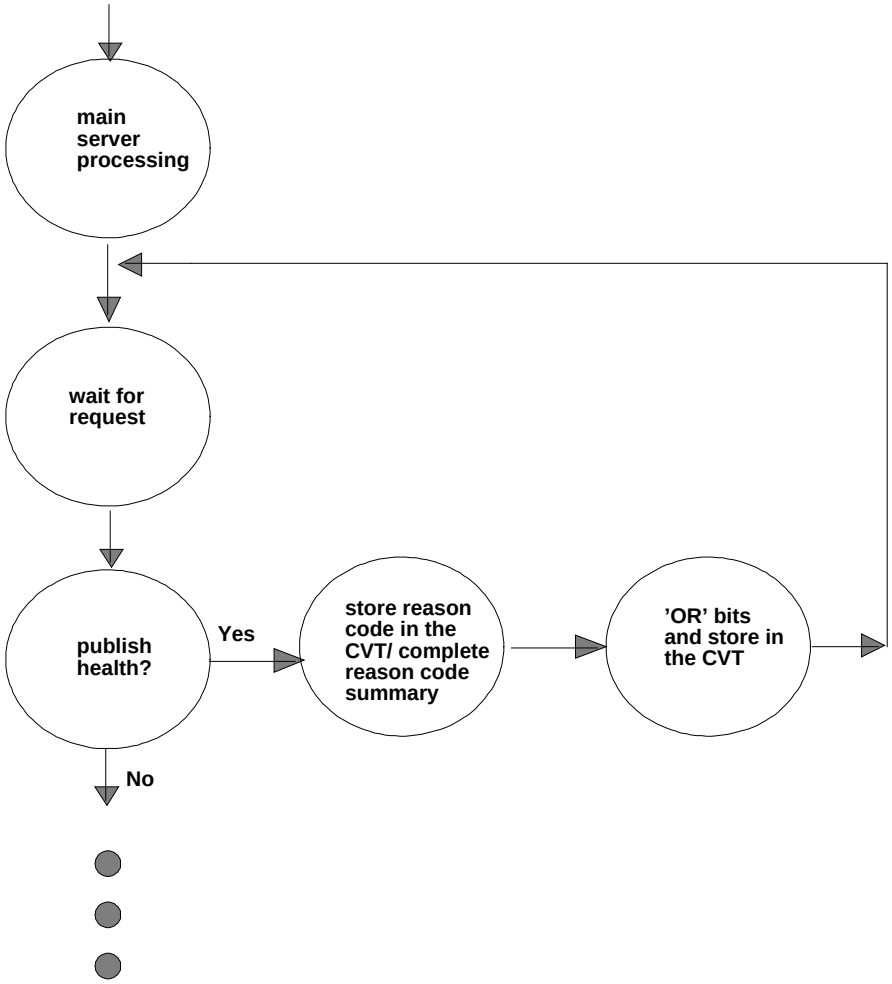
Reason codes are defined as 16-bit combination of F/W bit, User ID, and condition code. The reason codes are used to indexed into the Health message catalog.



During CVT initialization, the health bit for each FD is set to "warning" and the reason code is set to "01", indicating the FD data value is uninitialized.
When a Gateway becomes inactive, the health bit for all the associated FDs will be set to "failure" and the reason code will be set to "02", indicating the Gateway is down.

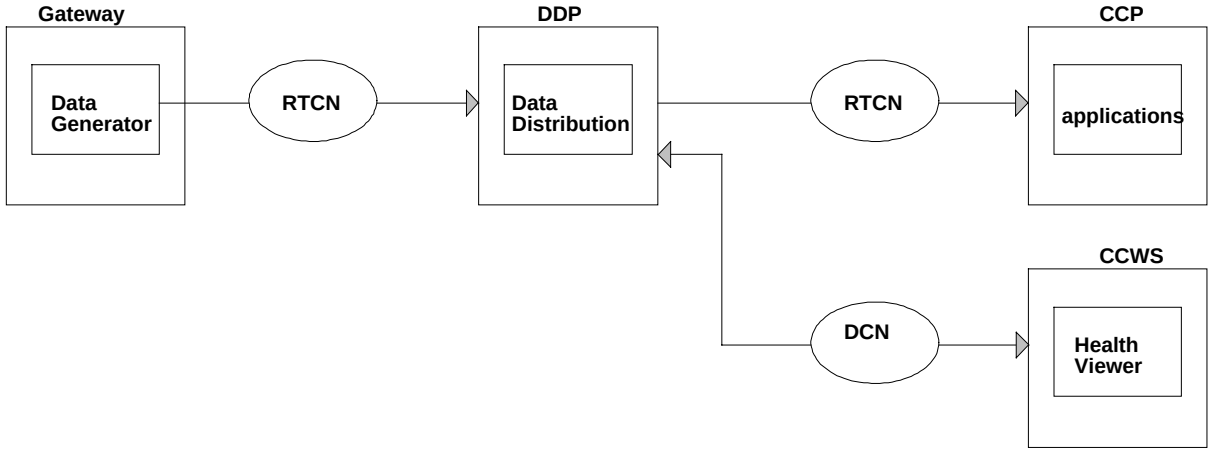
1.3.4 Data Health Structure Diagram

1.3.4.1 Server (DDP CSC)



1.3.5 Data Health CIT Test Plan

1.3.5.1 Environment (IDE)



1.3.5.2 Test Tools

1. Data Generator - used to output up to 20 data streams to the DDP
2. PC Goal - used to compare data values with values on the CCWS
3. Data Distribution - used to maintain the CVT
4. Health Viewer - used to display health algorithms
5. IPC Services - used to send health requests from the CCWS to the DDP
6. Data Health Function - used to process up to the ”system maximum data bandwidth” of FDs

1.3.5.3 Test Cases

1.3.5.3.1 Health APIs

DD Health API testing will be accomplished by the development of simple code sequences that will exercise the APIs.

1. Set the warning reason code for each of the ”set user” types for an FD.
2. Set the warning reason code for each of the ”set user” types for a list FD.
3. Reset the warning reason code for each of the ”set user” types for an FD.
4. Reset the warning reason code for each of the ”set user” types for a list FD.
5. Set the failure reason code for each of the ”set user” types for an FD.
6. Set the failure reason code for each of the ”set user” types for a list FD.
7. Reset the failure reason code for each of the ”set user” types for an FD.
8. Reset the failure reason code for each of the ”set user” types for a list FD.
9. Retrieve the reason codes for an FD name.

APPENDIX A

Statement of Work (Thor)

- Provide record and retrieval capability.
- Provide demonstration of a Ground Support Equipment Analog health value.
- Provide performance data for system modeling.
- Provide interfaces for End item Manager, Test Application Scripts, CCWS applications, and other applications to provide reason code(s) ~~and associated system messages~~ to Data Health.
- Provide the capability for the Data Health function to be utilized in both Operational and ~~Test Bed~~ application development configurations.
- Provide logging of error, performance and state change information.
- Baseline system messages using the System Message Catalog to include message and help text.
- Define and provide the Initial System Viewer capability for FD Health. The viewer will, for all health bits, display any reason information ~~including data path algorithms~~ with input and internal values. The viewer will allow updates at a TBD request rate. (Carried over from Redstone)
- Define and provide the Initial Pre-build ~~Data Path Health~~ Data Health FD list Editor. (Carried over from Redstone)
- Provide the capability to build Data Health Tables in the Test Build process. (Carried over from Redstsone)
- Provide a solution for users to define reason codes and their associated text. (New)

Performance Requirements from SLS

SLS 2.2.2.1.15 The Data Health Function shall support the “system maximum data bandwidth”.

Other Data Health Related SLS Requirements

SLS 2.2.5.2.1 The RTPS shall automatically track and maintain the health of all Measurement FDs.

SLS 2.2.5.2.2 Data Health information shall be updated any time the health changes.

SLS 2.2.5.2.3 The RTPS shall provide health information to all users and system or user applications of measurement information.

SLS 2.2.5.2.4 Users and system and user application shall have the capability to view health and status information on individual and groups of measurements.

SLS 2.2.5.2.5 The RTPS shall provide the capability to set and reset health and status.

SLS 2.2.5.2.6 The RTPS measurement FD Health function shall be fault tolerant.

SLS 2.2.5.2.7 RTPS Measurement FD Health shall include the known information about processing within CLCS including Gateway FD processing and redundancy management.

SLS 2.2.5.2.8 RTPS Measurement FD Health shall include the capability for manual input by engineering personnel.

SLS 2.2.5.2.9 CLCS shall provide the capability for users to define Data Path Health algorithms to be utilized by the RTPS Measurement FD Health function.

SLS 2.2.5.2.10 RTPS Measurement FD Health shall include the capability to interface with external systems to obtain data that assists in computing Data Path Health.

SLS 2.2.5.2.11 RTPS Measurement FD Health shall include the capability for User Advisory Expert System applications to provide Health Warning Indications.

SLS 2.2.5.2.12 CLCS shall provide the capability for Measurement Health to be persistent between different tests.

SLS 2.2.5.2.13 CLCS shall provide the user with the capability to selectively choose which Measurement FD Health is to be persistent.

APPENDIX B

Statement of Work (Redstone)

- Develop the Concept of Operations of how Data Health will be utilized by the User.
    - Define the list of Data Health requirements for both system processes and user processes.
    - Define the relationships between Data Health and other system processes such as Data Fusion.
- Define and then provide the Initial Pre-build Data Path Health Editor. The viewer will, for all health bits, display any reason information including data path algorithms with input with multiple FD's.
- Define and then provide the Initial System Viewer capability for FD Health. The viewer will, for all health bits, display any reason information including data path algorithms with input and internal values. The viewer will allow updates at a TBD request rate.
- Define the Databank impacts for Data Health and provide the capability to add Data Health and Data Path Health information to the Databank.
- Confirm and/or modify system data flow for data health.
- Confirm and modify System Services for data health.
- Confirm and modify the Data Health Bits.
    - Provide for Gateway Provided status
    - Provide for DDP generation health bits.
    - Provide for advisory and engineering inputs from CCP and HCI
- Coordinate design with Data Distribution, and Data Fusion.
- Determine is a COTS tool can be utilized and implement the selected approach.
- Provide the capability to build Data Health Tables in the Test Build process.
- Incorporate Data Health information into Data Distribution.
- Provide Initial record and retrieval capability.
- Provide demonstration of at least one end to end GSE Analog health value.
- Provide performance data for system modeling.
- Provide the capability for the Data Health function to be utilized in both Operational and Application configuration.

APPENDIX C

Data Health Thread Deliverables (Redstone)

The target Data Health tasks for Redstone consist of the following:

- Provide assessment and recommendation on long term Data Health operations
- Find the best of class tool for Data Health run time processing and for Data Path Editor. Common tools that can support multiple functions will be highly desirable. For example, a tool that can be used both as the Data Fusion Editor and the Data Path Editor.
- Incorporate health bits into Data Distribution.

The following deliverable products will be provided for the Redstone Delivery:

- Source code and executable software that support:
  - Incorporation of gateway supplied health bits into Data Distribution.
  - API to support application requests to set/reset specific health bit(s).
  - Interface between DDP and Data Health Manager.
- Data Path Editor specifications.
- Data Health run time specifications.
- COTS evaluation report to provide recommendation based on weighed criteria.

If an acceptable tool is found, the following will be delivered into the Application Test Bed environment:

- The COTS tool.
- Documentation provided by the vendors.
- Provide the capability to monitor the state of a predefined list of FDs against their predefined required states. When one or more fail to match, set the Data Path bit.
  - The list of FDs and the target state, will all be pre-defined in a manually generated file for Redstone. This file will be generated by the Data Path Editor for later deliveries.

The following will be implemented for post Redstone deliveries:

- Parse SCAN Discrepancy File and set the Functional Path associated FDs accordingly.
  - SCAN file will be parsed once per shift.
  - SCAN file will be manually loaded once per shift
  - The Functional Path/FD Mapping File will be generated by the Data Path Editor.
- Provide support to parse or analyze data generated by GSE and other Flight Systems, then set the Functional Path associated FDs accordingly
- Provide APIs to support the following interface:
  - Transition Tracking
- The list of FDs and the target state for Dependency tracking will be generated by the Data Path Editor.

The future requirements for Data Health, which include but are not limited to the following support, are not covered in this document:

- Parse SCAN Discrepancy File and set the Functional Path associated FDs.
- Parse and analyze data generated by GSE and other Flight Systems, then set the Functional Path associated FDs.
- Realtime monitoring of the state of a pre-defined list of FDs against their predefined required states. When one or more fail to match, set the Data Path bit.

APPENDIX C

Data Path Health Concept

Symbols and Abbreviations

*	Redstone Delivery Item
- - -	Non-Redstone Delivery Item
△	Change Data
(p)	Persistent Bit Status "ON"
(f)	Failure
(w)	Warning
	Engineer Manual Override
	Hardware "OR" Gate
SI	System Integrity
RM	Redundancy Management
DP	Data Path
CM	Constraint Management
EIM	End Item Manager
FP	Functional Path
FD	Functional Designator
SDF	SCAN Discrepency File
Sf	System Failure Bit
Sw	System Warning Bit
Hf	HCI Failure Bit
Hw	HCI Warning Bit
AI	Artificial Intelligence
A	Set by Wiring Integrity or Dependency Tracking or Transition Tracking